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An

Inaugural dissertation

on the

Influence of certain causes on the decarbonating function of the Lungs —

C. E. Pearson
N. Jersey 1813

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In considering the subject of general Anatomy [illegible] [illegible] which [illegible] [illegible] [illegible] the [illegible] of the [illegible] [illegible] light on the functions of [illegible] of the organs in the [illegible] [illegible] as well as the [illegible] of the [illegible]

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On Certain causes which influence the decarbonating functions of the Lungs. —

In the various departments of Natural Knowledge the influence of the late rapid advancement in chemical Science has been extensively felt; and this influence has by no means been withheld from the physiology of the Animal body. It has shed light on the functions of several of the Organs in the human economy, but on no one, so much as that of the Lungs — Since the successful investigation of the Nature of our Atmosphere, our knowledge of the uses of respiration has advanced apace. And the present highly perfected state of this knowledge proves, how important and curious the subject has been considered, and with what assiduity it has been pursued. Without giving an entire history of the progress of investigation in this branch of physiology, I shall briefly state what is the Amount of our present information respecting it, and then proceed to apply it to the purposes of this essay. —

The latest experiments on this subject are those of Messrs Allen Pepys — the result of their labours is the establishment of the following conclusions —

1st. The inspired Air imparts None of its Oxygene, Nor Nitrogene to the blood. —

2nd. The blood loses a principle viz. carbone, which by its union with the Oxygene of the inhaled Air, forms carbonic Acid gas. —

3rd. The watery vapour found in the expired Air, is the serous discharge from the surface of the bronchial tubes —

4th. The Blood derives heat from the decomposition of the inspired Air, all the latent heat of the Oxygene gas not being necessary to —

the formation of the carbonic Acid gas. –

th The dark colour of the venous blood, is owing to its being surcharged with carbone; and the bright scarlet colour, of the arterial blood, to its parting with carbone, in the process of breathing. –

The experiments of those Gentlemen have been conducted on a much larger scale, and with more vigilant endeavours, to fortify against all sources of error, than those of their predecessors; and they had a more improved, state of Chemistry to aid them in their labours. Their conclusions as to the products of Respiration, are not widely different from those of Crawford Lavoisier & Davy. For the most prominant circumstance of respiration was considered by the latter chemists, to be the separation of carbone from the blood. But as to the quantity of Oxygene consumed, the place of its union with the carbone, and the source of the aqueous vapour, there is a greater disagreement.

It would then appear, that the principal design of Respiration is to separate from the blood a Matter, which if retained in any considerable quantity, is extremely deleterious to life; but which in a certain limited quantity is harmless. Carbone enters largely into the blood as a part of the Chyle; and but a small portion of it seems to be expended in the process of Nutrition and secretion. The design of this surplus perhaps is, to promote the conversion of chyle into perfect animalized blood; and to assist in effecting those de=composition and new combinations which occur in Nutrition and Secretion. Having answered the above purposes it is conveyed out

of the system chiefly through the *lungs*. Carbone is then an excretion, a term which was first applied to it by Professor Coxe of this University. He considers its separation from the blood not as a secondary circumstance, and one merely instrumental to the production of Animal Heat; but as a process primarily and in itself essential to the healthy condition of the Animal Machine. –

Having given this preparatory sketch of what occurs in respiration, I proceed to state a conjecture, which I shall endeavour to support in the subsequent part of this essay. viz. that there are certain circumstances affecting respiration, which subject the human system to such a retention of the Carbone of the blood, as to be morbid, and cause derangement and disease. I am not to be considered as speaking of those sudden, and absolute interruptions of the function of the lungs, which constitute asphyxia and suffocation; but such as are not the effect of Accident, and arise from causes which are gradual and extensive in their operation. There are obviously 3. circumstances on which must depend the more or less perfect decarbonation of the blood. The velocity of the Circulation of the blood; the state of the atmosphere breathed; and the freedom with which the air is admitted to the extreme pulmonary vessels. According to this general division will be arranged the few facts and arguments, by which I shall attempt to defend the above position. But of those causes which influence the Circulation, I propose to confine myself to one. viz. *Exercise*. —

IV. Effects of Neglect of Exercise on the excretion of Carbone in the Lungs.

That a deficiency of bodily exercise causes debility and disorder of the body, requires no proof. It is equally certain that a considerable degree of it is necessary to insure ordinary health. The experiments of Lavoisier Seguin and others, have proved, that in exercise, there is a great augmentation in the discharge of carbone from the lungs in respiration. The mention of one of these experiments will suffice, as the others were followed by the same results. Seguin examined his own respiration in a state of rest, when it was found that 1344. cubic inches of Oxygene gas ~~are~~ were consumed per hour. After briskly exercising for a quarter of an hour it was found that he consumed Oxygene at the rate of 3200 cubic inches per hour. which is 1856 cubic inches more than when in a state of Rest. Chemists have proved that a volume of Carbonic Acid gas, is precisely equal in bulk, to that of the Oxygene gas which was requisite for its formation. Consequently in this experiment, there was separated from the blood in exercise, per hour, as much more carbone than is given out during rest, as enters into the composition of 1856 cubic inches of carbonic Acid gas. With this fact, resting on experiment, before me, I cannot consider it altogether fanciful, to suppose that protracted inactivity of body should be productive of some kind of inconvenience to the system, solely from the failure

of the lungs to excrete the due quantity of that principle, which we all know in a very trifling excess, shews sensible deleterious effects. That tolerable health requires some exercise daily; that good health requires much; and that luxuriant and vigourous health and strength of body are found only where there is habitual and laborious exercise, I need not spend time to prove. As it appears then, that the quantity of Carbone which the circulation parts with rises with the increase of exercise; and as the degree of health follows with equal step, is it not a rational inference, that this condition of the body may be in part ascribed to the pure and decarbonized state of the circulating Mass? On the other hand, when exercise is almost entirely abstained from, must it not consequently follow, reasoning from the above experiment, that some accumulation of Carbone will take place in the blood, and this too, of sufficient importance to create the well known train of diseases which are consequent to a too great neglect of exercise? If this accumulation of Carbone be denied it must be on the supposition that its admission into the circulation by the lacteals —— is diminished just in the proportion in which its excretion in the Lungs is restrained. This precise balance I think cannot exist. The existence of such a correspondence between the respiratory and chylopoietic organs, has never been presumed, and is inconsistent with the known uniform and independent action of the latter. I suppose then, that the purity of the blood as respects the Carbonaceous matter, may vary within a certain healthy

range. But this range is within narrow limits. I further suppose that it does not require a total omission of exercise to carbonize and debase the blood below its healthy range; but that even the moderately indolent and negligent of exercise are injured. It is well known that the blood of persons of sluggish and inactive habits is of a darker colour than that of such as lead a different kind of life. The following fact related by Mr Bichat shows how dependant the colour of the blood is on causes which accelerate or retard its circulation. He says he has often observed the blood which flows during a surgical operation to change its colour to dark, and from that to a red again, according as the circulation was affected by the fear, faintishness struggles or cries of the patient. If then a surcharge of Carbone does follow a protracted and habitual inactivity of body, I think we may infer from our knowledge of the consequences of the more obvious retentions of this principle, that a morbid condition of the system must result; and to this cause in a great measure are to be referred a long train of affections which attend an indolent and sedentary mode of life, and which though often slight do always exist. They are general debility, and relaxation, dyspepsia, constipation, a languid and feeble circulation, a sickly and sallow complexion of the skin, obstructed visceral, bilious symptoms. low spirits, ~~[illegible]~~iresolution and torpor of intellects, vapours, nightmare, failure of the secretions, and obesity &c.

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It may be thought difficult to see how disorders of the character of those I have named, should proceed from the blood being too highly charged with the carbone. But I must observe, that all of those disorders originate in a depressed and enfeebled state of the whole system, and are most of them in fact, mere symptoms of such a condition of the system. Now it is amply shown by the experiments of Bichat that a similar condition of body is induced by a redundancy of Carbone in the circulation. He proved that by injecting venous blood into an Artery, the action of the Artery was diminished in strength, and the part which it supplied greatly enfeebled. He also directed the venous blood out of the vein into the Artery by establishing a communication between them; and a degree of sedative effect took place in the organ concerned approaching to complete paralysis. By means of a canula and tube, he connected the crural-Artery of an Animal with the carotid of Another, and by producing a partial asphixia in the latter Animal, the crural Artery of the former was made to receive dark venous blood. The consequence was a temporary destruction of the Motions of the Leg. If it were necessary, many additional facts might be brought, to prove that the effects of carbone in unusual quantities are deadly sedatives. The observation of every one will inform him, that a well formed thorax and capacious lungs, are invariably accompanied with a ruddy countenance, and strength and vigour of constitution;

and that a contracted thorax and a confined state of the lungs are the concomitants of a feeble circulation of a pallid or bluish skin, purple lips, and a weak and emaciated body. Observe also the meagre and half animated frame of the unfortunate puer Caeruleus. This sedative action of carbone may arise either from its direct sedative quality, or from its composing with the blood a fluid, which affords a stimulus inadequate to the motions of health. When we reflect then how serious is the derangement from a trifling exceſs in the circulating carbone, as appears from the above experiments, and the familiar one of holding ones breath, we cannot be surprized, that circumstances which have the least tendency to cause this exceſs, should in time be followed by sensible morbid effects. It is truly wonderful, as the system is placed in such a variety of situations, and exposed to the action of such a variety of agents, that this decarbonizing function, the most eſsential to animal existence, should be so steadily and correctly performed, as not more frequently to occaſion disease.

It is now admitted by the best of Surgeons, that in Ulcers exercise is a valuable remedy, especially where much motion is not required in the part where the Ulcer is situated, in taking the exercise. It is used in many of the foreign Hospitals with succeſs – Dr Jackson makes some observations highly in favor of this practice in wounds. He tells us "that "Those British Soldiers who had been wounded in battle, who were turned out of the Military Hospitals, & followed the army, soonest recovered of their wounds. It was remarkable that if they delayed only a few days on the road, their wounds grew worse, or ceased to heal." The ulcers which are most benefitted by this remedy are those

of weak action, and where granulations are relaxed and of a dark, or purple colour. Now, Bichat, in his experiments to ascertain the cause of death from asphexia, observed that by an interruption of the breathing, as in partial asphexia, the granulations of an ulcer became of a livid colour, proving that this colour was owing to a redundancy of Carbon in the blood. These granulations frequently die and slough off. It appears to me highly probable that the continued State of inaction of those confined by wounds, and ulcers, begets a too carbonated condition of the blood, and the modus operandi of exercise is, by purifying the blood.

Who has not observed exercise to act like a charm in the case of the convalescent, dyspeptic, and the phthisical? who has not seen the enervated Melancholick, and the bedridden victim to vapours and Nervous derangement, forced into a state of locomotion against his own reason and inclination, and regain at once his wonted health, when Medecine had been administered in vain? There is an unaccountable promptitude in the restorative effects of exercise in many cases, which I suspect can in no way be so rationally explained, as by the view which I have taken of the respiratory function.

It may be objected that in case of bad wounds, and fractures, where there is very long confinement without the least exercise, none of the bad consequences that have been named, are observable. But in such cases the food is always small in quantity. Besides many facts might be adduced to shew, that

those who are confined from the above causes, are liable to a variety of affections which are solely owing to being for a long time deprived of exercise.

I have mentioned obesity among the disorders from a deficiency of exercise. We frequently see persons who lead very indolent lives and who were of a lean habit suddenly acquire such an acceſsion of fat, as to entirely change their appearance. The quantity is encreased in every part of the body, but the increase is especially observable in the omentum creating what is usually stiled a corporation. I have called this overgrowth of fat a disorder and such it surely is. The fibrous or fleshy parts of the body are rather leſsened than increased. The fat is then a useleſs incumbrance, mere excreſsence, a morbid deposition of a substance which the system from its being subject to long inactivity had not the power of throwing out, by the natural outlets, but to prevent more formidable diseases, had removed it out of the circulation into receptacles where its presence would be comparatively without danger. Now it is remarkable

that by chemical analysis, fat is found to contain Carbone in the proportion of four fifths ~~or more~~ of the whole. The remaining ingredients are Oxygene and Hydrogene — As then during abstinence from exercise we see the discharge of Carbone in the lungs very materially abridged, and at the same time a formation of a new substance, composed chiefly of carbone, no circumstance existing to make the chyle different in quantity or quality, are we not compelled to conclude that they stand in the relation of cause and effect. The conclusion is strengthened by the fact, that the Aqueous exhalation from the Lungs, which is also diminished as well as the excretion of carbone, is composed of the elements which are the remaining constituents of the fat. Infants have a vast proportion of fat; but as soon as they are old enough to take exercise they throw it off and become well proportioned. In examining different classes of Animals, it is found that the proportion which their fat bears to the rest of the body, is inversely as the exercise which they take. It is also found that if they be ranked according to the perfection and importance of their organs of respiration, it will be the reverse of the order in which they stand, in point of quantity of fat. Most fish and amphibious Animals abound in fat, their lungs being of the lower order, while as we ascend to quadrupeds and birds we perceive less fat, and a more complete State of the lungs. It is well known that poultry will fatten when shut up, in our

third of the time that they will if allowed to run out. But the limits of this eſsay will not admit of my being particular on this head, although a further examination of the relation of the respiratory function, and the secretion of fat, would add much support to the opinion I am defending. Among the consequences of too little exercise, I have named Bilious symptoms. It is very common to see the Sedentary Student, and mechanic, with a yellow tinge of the eye and Skin, bilious stomach, and aching side. But in what manner this is caused by a redundancy of carbonaceous matter in the blood, will appear in the next division of the subject. Habitual exercise without any other remedies will remove bilious affections of this kind. —

The effects of Rarified State of the Air on the Quantity of Circulating Carbone.

As a rarified State of the Air we breathe, may depend either upon its high temperature, or in a diminution of weight in the Atmospheric column, I shall observe a corresponding division in treating of its consequences.

1st Effects of an Heated Atmosphere

The experiments of Drs. Crawford, Lavoisier, and Seguin, have ascertained that the quantity, Oxygene consumed, or of Carbonic discharged, is inversely as the temperature of the respired air. It will suffice to mention one experiment, as others are similar in result. The quantity of Oxygene consumed by a man in an hour, when breathing air of the temperature of 54°. was found to be 1344 cubic inches. When the air was raised to 79° only 1210 cubic inches of Oxygene gas were consumed per hour; a difference in favor of the lower temperature, of 134. Cubic inches. I before observed that Carbonic Acid gas is exactly equal in volume to the Oxygene gas consumed in its formation. Therefore by elevating the temperature of the air we breathe, from 54°. to 79°. the blood parts with

as much leſs carbone ꝑ hour, as enters into 134 cubic inches of carbonic Acid gas. See Note — If so palpable then, is the variation in the Amount of excreted carbone in variations of temperature, it is natural to enquire if the system does not suffer

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Note. Dr Crawford placed a dog in Air Raised to the temperature of 131°. After a short confinement in this Situation, the oxygene consumed was found to be much leſs, than what was consumed by the same Animal in air of the usual temperature. But he says notwithstanding, that the venous blood was rendered of a lighter colour, by breathing the heated Air. But as leſs carbone was discharged from the lungs, he concluded that the change of Arterial into venous blood, was prevented from taking place, to the natural extent. Concerning this experiment, I have only to observe, that the situation of the Animal was so unnatural a one; the impression from the exposure to air so highly heated, was so sudden and violent, that the usual operations connected with the Circulation must have been materially deranged or partly suspended, and of course that it cannot be considered as an experiment of any bearing in the present enquiry —

from the retention of this principle when exposed for a long time to an atmosphere heated much above the usual degree. Does the Pennsylvanian, or Englishman, fix his abode for the summer under the scorching heat of Cayenne, Sumatra, or Sierra Leone, and feel no inconvenience, suffer no disorder, from the above cause? do his Lungs emit 3216 cubic inches of carbonic acid gas less per day, than in the same season in his own Country, and yet without detriment to his system? But may not the quantity of carbone prepared, and admitted into the circulation, be diminished in the same ratio? Surely not, for his diet which in his own country was chiefly animal, in the tropical country, is (agreeable to custom and necessity) almost entirely of a vegetable nature, which contains vastly more carbone than the Animal. See note. But if the ingress of carbone is not altered, may not ~~[illegible]~~ other avenues convey it out of the System, and its accumulation thus be prevented? This unquestionably must to a great degree, be the case, or he could not exist under such a

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Note. That more carbone is conveyed into the blood by vegetable than by Animal diet, is evident from the fact, that the former increases the fat of the body much more than the latter. The adipose matter of Carnivorous Animals is very small, compared with that of Animals, which feed on vegetably. Carbone is the principal ingredient in fat, while it is scarcely found in the other solids of the body —

failure in the function of the Lungs. Which then are the emunctories, which come to the relief of the Lungs in the business of decarbonizing the blood? The skin has been supposed to perform a function similar to that of the lungs. That it does so, seems sufficiently established by the experiments of Count De Silly, Cruickshanks and the French Chemists. But the quantity of carbone discharged in this way has not been precisely determined, and is not considerable. I shall therefore in this place give it no further attention.

There are not wanting facts which go to make it highly probable that the liver is concerned in an office of this kind. Heat greatly increases the secretion of bile, and determines to the liver. The endemic of all hot countries is bilious complaints. Strangers especially during a residence in such countries manifest every appearance of being surcharged throughout their systems with bile, even when they have escaped bilious diseases. No one ever thought the miasmata of warm climates sufficient of itself to account for the universal prevalence of billious diseases, exclusively of the agency of heat. But still perhaps, too much is ascribed to miasmata. In situations where miasmata could not exist in sufficent quantity to cause disease, if the heat is intense, billious complaints nevertheless abound. It is true, that in the production of the mortal epidemic and endemic billious fevers of hot countries, miasmata may be chiefly concerned. But even here, the heat may be the sole agent in giving the disease the character of bilious. The heat may

oppreſs and weaken the system with the bile it generates, by which a predisposition is created to fever, the Miasmata acting merely as the exciting cause. And the liver having previously been more exposed to the predisposing cause than other parts of the body, will be most affected, and give rise to the leading symptom of billious fever, which gives it its name. It is difficult to perceive how miasmata should act specifically on the liver.

But let us examine further, what facts can be adduced, in support of my position that the Liver is an assistant to the Lungs in decarbonizing the blood

1st. The bile abounds in carbone. It is found by Chemists to contain more of it than any of the other fluids of the body. See examinations of bile by Fourcroy, Blumenbac, and Murray. The latter Chemist was so struck with its predominance in the bile, that he was impelled to the conjecture, that one of the uses of the liver might be to convey Carbone out of the blood.

2d. The bile is secreted from the venous blood. It is a curious circumstance, that all the other secretions of the body are made from the Arterial or florid blood; while the bile alone is made from the dark or carbonated blood. The reason of this peculiar economy has been a source of much speculation among physiologists; and they have finally agreed to consider it as a contrivance by which the blood is prepared for the secretion of the bile. But

in what this preparation consists, was very imperfectly known until the improved Chemistry of modern date discovered the blood in the Vena portæ, to be loaded with carbone, and to contain in a peculiar degree those qualities which characterize venous blood, and are best suited to the formation of such a fluid as the bile.

It is thought that the greater capacity of the veins of the Porta by causing a sluggish movement of the blood, favours this state of the blood. - But are we to consider this structure to be a special ~~station~~ provision in favor of the liver, and the parts to which it sends its bile, or that the liver is an organ made to serve the system of the Porta, especially, and the whole circulating system occasionally. - The latter is the opinion which I am disposed to adopt. I assign to the liver the office of carrying out of the system of the Porta its excess of carbonaceous matter, and of acting sometimes as an auxiliary to the lungs. There are several considerations which favor this opinion. I have before said that the skin had been proved to perform a function similar to that of the lungs. This being the case, it follows that the venous blood which comes from every part of the surface of the body, may be expected to be less dark, and carbonated, than that which is returned from the central or visceral parts of the system. The Porta circulates a great proportion of the whole blood. It collects that, which had supplied the very extensive surface made by the stomach, spleen

Omentum), the whole range of the intestinal canal, and the mesentery, a surface not much inferior to that of the whole body. This blood has undergone no change at the extreme vessels like that which takes place on the Skin, and is accordingly found to be darker, and to contain much more carbone than the rest of the venous blood. The liver is known to separate this carbone, and to discharge it, in the composition of bile, of which it is the chief ingredient. Therefore, have we not reason to suspect that a prominent use of the liver is to decarbonize the blood? If it be said that this account of the function of the Liver degrades this organ from the rank of a secretory to that of an excretory one, I answer, that this does not follow; for it is not to be denied that the bile answers an important purpose in the process of digestion and Chylification, and as respects the bowels is a secreted fluid. This view, then, of the origin and destination of the bile gives us one instance out of many, of the simplicity and economy which nature has observed in constructing the animal machine.

d.) I infer that the liver acts as an assistant to the lungs in decarbonizing the blood, from the absolute necessity of such an assistant. The Lungs are much dependant on external circumstances in the performance of their function, and are influenced by causes which are extraneous, and over which the system has no controul. Such are the variations of atmospheric temperature and weight,

d exercise. The lungs are as it were passive; or to make use of a figure from Science the lungs are a fixed quantity, and the ex=ternal agents the variable ones. The result will always of Course be as the latter. Now, when we consider how precise the system is, with respect to the quantity of circulating carbone it will contain without offence, and how liable this quantity is to fluctuate, from unavoidable causes, we should expect to find in the body, a contrivance analogous to what the chemists call a valve or tube of safety, which would permit the escape of surplus carbone, and save the system from fatal injury. Such an office I conceive the liver to perform. –

In another point of view, there appears to be a necessity for an Organ which shall act as an assistant to the lungs. The human body is so constructed as to be adapted to all climates, A striking instance of this adaptation appears in the diminution which occurs in the production of Animal heat, when the body is placed in heated situations. This is one great means by which the body is kept at one uniform point of temperature. A stranger in a hot climate, could not subsist if his lungs continued to Manufacture their accustomed quantity of animal Heat. Reason and experiment prove they do not. Now, the decarbonation of the blood must be diminished as well as the formation of animal heat in the lungs, as they precisely correspond in their variations, being the result of

of one and the same process. But health and Life forbid any considerable relaxation of the decarbonating process. Therefore if the lungs are not enabled to perform it to the due extent, it is necessary that there should be, and we naturally look for some auxiliary organ which shall perform a similar function, but in such a way, as shall be unattended by any perceptible evolution of free caloric to augment the animal heat. Such an organ is doubtless the Liver.

While I am speaking of the relation between the lungs and the liver, I cannot but allude to the probability that in the foetal state, the liver supplies in a measure the place of the lungs. The meconium is beyond doubt produced by the Liver, and is found in the intestines during almost the whole period of gestation. By chemical analysis, it is found closely to resemble the adult bile, and to consist chiefly of carbonaceous matter. It is said that the blood returned from the placenta ~~by the~~ ~~umbilical~~ by ~~the~~ the umbilical vein, is more florid than that in the umbilical arteries. This may be the case, and yet the liver perform the office of lungs. For the business of decarbonation may be but in part executed in the lungs, while the liver does the remainder, and perhaps the chief of it. Richerand is of this opinion. I leave this subject by asking the following questions. Why does the liver secrete a biliary matter in the foetus, when it can answer no purpose

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in the intestines, while the kidneys are not brought into action untill after birth? Why is the liver of the Foetus so overproportioned to the rest of the body? Why is the blood of the Umbelical vein made to circulate through the substance of the liver before it reaches the heart and is distributed over the whole system?

By what has been said, it is indeed highly probable that the liver is an organ of more consequence than has generally been attached to it; that besides the relation in which it stands to the intestines, it acts in a similar way with the Lungs on the whole circulation, but more especially on the Central part, or system of the porta. It may be conjectured where there is a bilious colour of the skin, and other symptoms of bile in the circulation, that such symptoms may be owing merely to an obstruction in the Liver and not to any increase in the quantity of bile formed, nor of the materials furnished for its formation. But the best writers on bilious diseases inform us that bile exists in excess in the primæ viæ, at the same time that it does in the blood. Dr Saunders says, "in the endemic of the West Indies in which the skin is obviously tinged with bile, there seems rather a redundancy of it in the primæ viæ than a deficiency"?

It may be said, that if in hot climates, carbone accumulates, the blood on examination ought to shew appearances of it —

This will appear to be the case. Dr Matthews in his account of the diseases of the East Indies, observes that he found the blood frequently very dark and in many cases black, and viscid. He further observes that "during the rainy seasons, and at the approach of the Cooler Months, the blood changes to a florid colour. In the other Months in this climate we have never noticed the same appearances". These remarks were made on the blood drawn at the different seasons, and not only in belious diseases but some others.

But bilious affections are not confined to warm climates. If my former reasoning is not fallacious, I conceive that the tendency to belious complaints towards the end of a hot summer in our own climate, may be explained by the same reasoning. Our Summer's heat is frequently equal to that of the W. Indies; and when this heat is lasting there is almost an universal belious diathesis. Belious fevers, and belious, vomiting and purging, are extremely prevalent, not only in cities, and marshy situations; but in the country, and in the most healthy situations. Now it appears a mere assumption, and one without plausibility, to say that the heat has acted directly on the liver, and produced these diseases. It is not easy to conceive of an agent, acting constantly on an organ for many days and weeks, before its effects are at all manifested; and when manifested, appear with a violence proportionate to the time it had acted. But this difficulty does not occur in the

view I have taken of the causes of bilious affections. —

Among the effects of heated atmosphere, on the constitution of man, I ought to mention the change of complexion which occurs in those who visit hot countries. This change is striking even during a short residence in such climates; but those who spend a life there, have their skins changed to a tawny or brown colour. While such as have descended from an ancestry, which had for many generations been exposed to the intense influence of a vertical sun, are of a black colour. In accounting for this change of complexion on the principles I have been advocating, I am not entirely singular. Blumenbac supposed, that by the action of the sun on the fat under the skin, a carbonaceous matter is separated, giving the skin a dark tinge. But it is more probable, that this dark pigment is deposited under the cuticle by the blood. If the action of the sun or of heat, on the surface, was alone the cause, parts which were excluded from this action, would not be discoloured, which is contrary to fact. It is known to anatamists, and was first observed by M. Meckel, that the medullary substance of the brain of the negro, is much darker than that of the European; and that a cut surface of it, being exposed for a little while, to the air, turns as white, as the medulla of the European. Here there is no fat, & the suns rays cannot act. The disappearance of the colour, on exposing it to the action of the air, makes it extremely probable that carbone is the colouring matter.

Effects of Rarefied Air from diminished Weight of the Atmospheric Column.

As there is a considerable variety in the weight of the atmospheric column, as appears from the changes in the Barometer; there must be a corresponding change in the density of the air, and consequently a variation in the quantity of Oxygene contained in a given bulk — As this variation is not inconsiderable, I shall briefly enquire, if such a rarefied, diffuse state of the Atmosphere, as occurs within the ordinary range of the barometer, may not be so unfavorable to a due decarbonization of the blood in respiration, as to occasion bodily derangement.

The accounts which aëronauts, and those who have ascended to the tops of high mountains have given of their sensations and ailments, sufficiently prove that the air of the higher regions is incapable of satisfying the demand of the lungs for oxygene. Sir Wm Hamilton experienced great difficulty of breathing, and debility on Mount Ætna. —

M. De Sauſsure, while on the summit of Mount Blanc, was "extremely oppreſsed in his breathing: his strength was also exhausted to such a degree that he seemed to require four times as long a space to perform some experiments on the top of the Mountain as he would have done at the foot of it". This unfitneſs of the air of the higher regions for respiration, is not owing

to the Oxygene bearing a smaller proportion to the Nitrogene, than it does in the lower regions. For, it is now satisfactorily proved, by the Analysis of air brought from great hights in bottles by Aeronauts and travellers, that the constituents of our atmosphere, are in a fixed and uniform proportion at all heights.

At the medium level of the Earths surface, when the weight of the air fluctuates between 28.° and 31.° of the Mercury, the effects of light atmosphere are similar, though less in degree. When the Barometer sinks to 28.° indicating what is vulgarly denominated a heavy air, but which is the reverse, our feelings are materially changed. Every one complains of lassitude, debility, and low Spirits; many of headach, loss of appetite, drowsiness and vertigo. The circulation, and other Motions of Life are depressed and enfeebled. We feel as if our bodies were subjected, to the action of some sedative and debilitating agent. The phlegmatic, hypochondriack, consumptive, and asthmatic, suffer most. These effects have been imputed solely to the loss of Atmospheric pressure, which the body sustains. That this loss of pressure may assist in producing them, is very possible; but that it is the sole or principal cause is without any proof. The consequences of diminishing the mechanical support, which the air affords to the body, such as the expansion of the circulating fluids, distension of the veins and arteries, &c, are imaginary. Says the writer

f the Article "Atmosphere" in the British Encyclopedia, "In that kind of weather when the pressure of the Air is least, we never perceive our veins to swell, nor are we sensible of any inward expansion in our bodies. On the Contrary the circulation is languid and seems rather to be oppressed by a weight. Even in going up to the tops of high mountains, where the atmosphere is diminished more than 3 times what it usually is on the plains, no such appearances are observed."

It may be shown that in a light atmosphere, there occurs such an interuption in the decarbonizing function of the lungs, as to furnish an adequate explanation. - In the Minutes of the "Society for the promotion of Philosophical experiment," is an account of some experiments made by an eminent chemist on animals placed in an Air pump Receiver. He proved that by rarifying the air only to the degree to which the atmosphere is occasionally brought in the ordinary changes of the weather, the animal consumed but one half the quantity of Oxygene, which it did at the common density. From this, it would follow, that at 28° of the barometer, the blood loses but half the quantity of Carbone, that it does, at the medium height of the barometer; that is, if we admit an exact analogy between the rarefied Air of the receiver, and the rarefied atmosphere; and that between the changes on respired air in the lungs of the animal, and of man. - If these Analogies are not exact, they are sufficiently so. If then, so remarkable a retention of carbonaceous matter takes place in a light atmosphere, how is it possible that the body should not feel inconvenience from it? The Carbone of

the circulation in more than the usual quantity, has been proved to be a sedative, diminishing or prostrating the energy of the motions of life. We should therefore expect a priori, that this condition of the atmosphere would occasion disorder, and precisely such disorders as have been mentioned. Asthmatic paroxysms are evidently induced by this cause, especially in those who are subject to them. Every Asthmatic finds a light atmosphere his bane. When the blood is not sufficiently decarbonated in the Lungs, its flow back to the heart is slow and languid, causing the blood to collect in the extreme pulmonary veſsels. The uneasineſs thus created throws the Lungs into spasms.

Dr Bree enumerates light air among the causes of Asthma, and supposes it to act by its not imparting a sufficient quantity of Oxygene to the blood.

The Asthmatic is much anoyed by damp weather, which may arise from two causes. 1st. The rarified state of the air, with which dampneſs is almost always accompanied. 2nd. The more the Moisture which exists in a given bulk of air, the leſs must be the quantity of atmospheric Oxygene, and proportionally the leſs fitted must such air be to answer the purposes of respiration.

Another circumstance which proves that asthma frequently depends on the cause I have mentioned, is the paroxysm attacking generally at Night when the suspension of all exercise favours a

carbonated state of the blood; and it is not till towards Morning, that the paroxysm occurs, when this carbonation of the blood may be supposed to be the greatest. (See Bree & Sir J. Floyer on Asthma)

From this account of the exciting cause of Asthma, we should a priori, pronounce the inhalation of Oxygene gas, or highly oxyginated air, to be a beneficial remedy in an asthmatic paroxysm. Numerous trials have proved the fact. Dr. Beddoes says, "no sooner does the Oxygene gas touch the lungs, than the livid colour of the Countenance disappears. The laborious respiration ceases, and the functions of all the thoracic organs go on easily, and pleasantly again" Dr Townsend speaks well of this remedy. ——

II Imperfect decarbonization of the Blood from Mucous Obstruction in the Lungs –

Among the causes of defective decarbonization of the blood, I may mention the mucous matter in the bronchial tubes, which prevents an extensive application of the inspired air to the pulmonary blood. Dr Bree speaks of this, being a cause of pituitous asthma, but still thinks the irritation of the mucus on the bronchiæ to be the chief cause. But when it is considered how constant, and abundant, in such cases this mucus is; and how large a portion of the bronchial surface is excluded from the action of the air, we cannot conceive it possible that the blood can be sufficiently decarbonated. The state of the system proves that it is not. The blood of the asthmatic

is unusually dark; his circulation slow and feeble; there is a great deficiency of bodily strength and vigour; the heat of his body is much below the common temperature; the extremities are always cold; the complexion is pale or dark and livid; in short, he experiences to a degree, all that variety of distreſs and infirmity, to which the unfortunate Blue Boy is a victim.

But what is, perhaps, still more in point, is the colour of the matter thrown out of the lungs, - Bree says he has frequently seen the mucus expectorated in Asthma, of a black colour. Morgagni, in his diſsections of those who died of Asthma, speaks of collections of a black substance in the lungs, which on being rubbed in the fingers, appeared to consist of a Carbonaceous powder. Dr. Morton observed such as laboured under pituitous consumption to expectorate a black mucus in the morning. —

Willis takes notice of the same thing. —

This view of pituitous Asthma, enables us to account for the very remarkable efficacy of emetics in this disease, as well as in consumption. They throw out the mucus, and instead of weakening, they invigorate the whole frame.

Peripneumonia is attended with more debility, more malignancy, and is more apt to sink the system into a typhus diathesis than the pleuritis vera, or other local inflamations. May this not arise from the obstruction, which the mucus lining the bronchial surface affords, to the neceſsary decarbonization of the blood. —

Before concluding, it is incumbent on me to make some apology for this eſsay. It may be considered, and I fear with too much reason, not only as Novel, but hypothetical, and wildly speculative. I must confeſs, that at my outset, had I foreseen the frailty of my materials, and the grotesque and unshapely structure I was about to raise, I might have left the work for a future visionary. But I thought I discovered many facts, pointing to the deductions I have drawn. I fancied that the subject had ~~[illegible]~~ truth ~~[illegible]~~ lurking within it, which might be elicited by the investigation; and in commencing it, I felt like the eager mineral hunter, who had wandered into some wild, and unfrequented spot, and commenced opening a pit: while his only aſsurance of meeting with the objects of his search he derives from the unexplored, and rugged aspect of the place. Perhaps I may now compare myself to the same mineralogist, who after toiling with his pickaxe and spade, until fatigued, finds himself in poſseſsion merely of a few paltry specimens, which he would leave where he found them, were it not for the mortification of returning home without any thing.—

~~Drowning~~ 1813

An
Inaugural Dissertation
Resuscitation
on the
[illegible] tating the [illegible]
from drowning

1813-
No 44 - No 76

Benedict D Potts.

Submitted to the examination
of the
Trustees and Medical Professors
of the
University of Pennsylvania
1813